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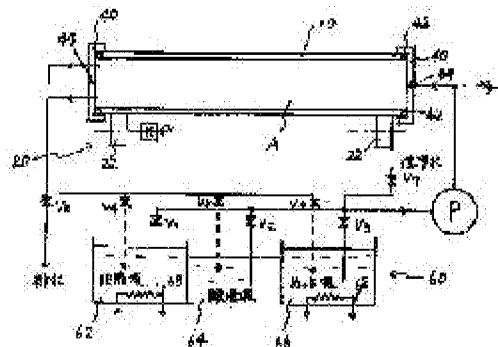
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(54) ELECTROLESS PLATING METHOD AND PLATING DEVICE FOR LONG-SIZED PIPE

(57)Abstract:

PURPOSE: To apply electroless plating on the inside or outside surface of a heavy-weight long-sized pipe with simple equipment and operation in a horizontal posture.

CONSTITUTION: The long-sized pipe 10 is horizontally placed on a supporting and rotating mechanism 20. A degreasing liquid, pickling liquid and electroless plating liquid are successively and forcibly fed to the inside of the long-sized pipe 10. The long-sized pipe is rotated during the plating, by which the inside surface of the long-sized pipe is electroless plated. The long-sized pipe 10 is concentrically housed into a sheath pipe of a large diameter and this sheath pipe is placed on the supporting and rotating mechanism 20 in the case of outside surface plating. The respective treating liquids are then forcibly fed into the annular space between the sheath pipe and the long-sized pipe and the sheath pipe is rotated together with the long-sized pipe during the plating. The pretreating to the plating are executable without moving the long-sized pipe with the smaller amts. of the plating liquids to be used. The high-quality plating film which has the thickness uniform in a longitudinal direction and a peripheral direction and is free from defects is thus formed.



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CLAIMS

[Claim(s)]

[Claim 1]To a building envelope of a long pipe which is an electroless plating method of an inner surface of a long pipe, and was supported horizontally. An electroless plating method of an inner surface of a long pipe which feeds electroless plating liquid next, performs inner surface plating of a long pipe, and is characterized by making a hoop direction rotate a long pipe during plating at least after supplying plating pretreatment liquid first and performing plating pretreatment of an inner surface of a long pipe.

[Claim 2]Are an electroless plating method of an outside surface of a long pipe, and it is supported horizontally and a long pipe is concentrically arranged inside a coat pipe of a reliance major diameter, After supplying plating pretreatment liquid to annular space formed between this long pipe and coat pipe first and performing plating pretreatment of an outside surface of a long pipe, Next, an electroless plating method of an outside surface of a long pipe which feeds electroless plating liquid, performs outside plating of a long pipe, and is characterized by making a hoop direction rotate a long pipe during plating at least.

[Claim 3]A closure lid of a couple which seals a building envelope of a long pipe with which an edge of a winding instrument of both sides of a long pipe to be plated was equipped, Electroless plating equipment of an inner surface of a long pipe provided with a liquid supply mechanism for supplying a treating solution to a support rolling mechanism which supports a long pipe horizontally and a hoop direction is made to rotate, and a building envelope of a long pipe via said closure lid.

[Claim 4]A long pipe to be plated supports concentrically a coat pipe and a long pipe which are accommodated in an inside in a coat pipe, and. A closure lid of a couple which seals annular space formed between a long pipe and a coat pipe and with which an edge of a winding instrument of both sides of a coat pipe was equipped, Electroless plating equipment of an outside surface of a long pipe which supported a coat pipe horizontally and was provided with a liquid supply mechanism for supplying a treating solution to a support rolling mechanism which makes a hoop direction rotate a coat pipe with a long pipe accommodated in an inside, and said annular space via said closure lid.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application]This invention relates to the plating method of a long pipe and a plating device suitable for plating the inner surface and outside surface of a metal tube of Ryo Oshige with a long picture like an oil well pipe or a line pipe by a nonelectrolytic plating method.

[0002]

[Description of the Prior Art]As for a steel pipe, according to an operating environment, a surface treatment may be performed to an inner surface and an outside surface. For example, oiling or thin film paint may be performed for the rustproof purpose. Plating of an inner surface or an outside surface is performed as surface hardening for making it equal to sliding or wear as a much more powerful object for rust prevention. As an example of plating of this kind, there are zinc or zinc alloy plating, chrome plating, nickel plating, cobalt plating, etc. Although zinc or zinc alloy plating is usually performed by the hot-dipping method or the electrolysis plating method among these plating, generally as for other plating, plating is performed by the electrolysis plating method or a nonelectrolytic plating (chemical plating) method.

[0003]Generally plating of a steel pipe is performed level, perpendicularity, or by making it incline and accommodating in a steel pipe into a bigger plating tub than a steel pipe to be plated. By this method, the internal and external surfaces of a steel pipe are simultaneously plated with nonelectrolytic plating. In inner surface plating, plating an inner surface is also known by closing the both ends of a steel pipe and supplying electroless plating liquid to the inside of a steel pipe by making this steel pipe into a plating tub. However, the method of plating only the outside surface of a steel pipe by a nonelectrolytic plating method was not established.

[0004]More in recent years, the production technology of a steel pipe improves, manufacture of a long steel pipe in which a seamless steel tube also exceeds 10 m is attained, and, in enlargement and the plater of the plating tub, movement of the steel pipe of a between poses a problem in connection with it. The large place was required to use the tub for plating pretreatment apart from a plating tub, and arrange many kinds of tubs conventionally. When a plating tub is large, a lot of plating liquid and each pretreatment liquid are needed, and compared with electroplating, the nonelectrolytic plating method with expensive plating liquid becomes disadvantageous in cost. Between each process, in order to also perform rinsing, it is generated so much by the required polluted water of waste liquid treatment.

[0005]Since the current ($I=V/R$) sent from both ends in the center section of a pipe falls with the electrical

resistance of a pipe in the electrolysis plating method, If it becomes a long pipe which exceeds 10 m, the fall of the current of the center section in comparison with tube ends will become remarkable, and the plating thickness depending on current will become remarkably small in the center section from tube ends. Therefore, in order to form the plating coat of uniform thickness, the length of a pipe has a limit.

[0006]However, since a plating coat generates a nonelectrolytic plating method by a chemical reaction called the deposit to metal from the metal ion by the reducing agent in plating liquid, if a reaction condition, especially temperature can be uniformly held within a steel pipe, it can form the plating coat of uniform thickness regardless of the length of a steel pipe covering an overall length. Therefore, since there is no restriction in the length of a steel pipe, the nonelectrolytic plating method is suitable as a method of plating a long pipe.

[0007]As a nonelectrolytic plating method of the inner surface of a long pipe, the method of plating by feeding electroless plating liquid inside the uprighted long pipe is indicated in JP,54-121239,A and 57-169097 each gazette. It is for securing plating homogeneity to upright a long pipe. However, it is also weight if it becomes the long pipe that length exceeds 10 m. It becomes difficult to reach 100 - 1000 kg and to plate by making it stand straight. That is, it is indispensable to plate with such a metal tube of a super-long picture and Ryo Oshige by a stable horizontal position in an equipment surface and a handling face.

[0008]

[Problem(s) to be Solved by the Invention]The purpose of this invention is a stable horizontal position, and is providing the electroless plating method and device of a long pipe which can plate the inner surface and outside surface of a long pipe uniformly and good. Another purpose of this invention is to provide the plating method and device which can plate the inner surface and outside surface of a long pipe with simple operation by a nonelectrolytic plating method without not needing a large place and using expensive electroless plating liquid so much.

[0009]

[Means for Solving the Problem]By this invention, it is following (1). - (4) A plating method and a device are provided.

(1) To a building envelope of a long pipe which is an electroless plating method of an inner surface of a long pipe, and was supported horizontally. An electroless plating method of an inner surface of a long pipe which feeds electroless plating liquid next, performs inner surface plating of a long pipe, and is characterized by making a hoop direction rotate a long pipe during plating at least after supplying plating pretreatment liquid first and performing plating pretreatment of an inner surface of a long pipe.

[0010](2) Are an electroless plating method of an outside surface of a long pipe, and it is supported horizontally and a long pipe is concentrically arranged inside a coat pipe of a reliance major diameter, After supplying plating pretreatment liquid to annular space formed between this long pipe and coat pipe first and performing plating pretreatment of an outside surface of a long pipe, Next, an electroless plating method of an outside surface of a long pipe which feeds electroless plating liquid, performs outside plating of a long pipe, and is characterized by making a hoop direction rotate a long pipe during plating at least.

[0011](3) A closure lid of a couple which seals a building envelope of a long pipe with which an edge of a winding instrument of both sides of a long pipe to be plated was equipped, Electroless plating equipment of an inner surface of a long pipe provided with a liquid supply mechanism for supplying a treating solution to a support rolling mechanism which supports a long pipe horizontally and a hoop direction is made to rotate, and a building envelope of a long pipe via said closure lid.

[0012](4) A long pipe to be plated supports concentrically a coat pipe and a long pipe which are accommodated in an inside in a coat pipe, and. A closure lid of a couple which seals annular space formed between a long pipe and a coat pipe and with which an edge of a winding instrument of both sides of a coat pipe was equipped, Electroless plating equipment of an outside surface of a long pipe which supported a coat pipe horizontally and was provided with a liquid supply mechanism for supplying a treating solution to a support rolling mechanism which makes a hoop direction rotate a coat pipe with a long pipe accommodated in an inside, and said annular space via said closure lid.

[0013]

[Function]In the electroless plating method and plating device of an inner surface of a long pipe concerning this invention, long pipe itself which was supported horizontally is used as a plating tub, and let the building envelope of this long pipe be a plating room. And the inner surface of a long pipe is plated by supplying electroless plating liquid to this plating room. In order to make capacity of a plating room still smaller and to save the amount of the plating liquid used, a stick or a pipe may be preferably inserted in the inside of a long pipe concentrically with a long pipe. In that case, the annular space between this stick or pipe, and long pipe serves as a plating room.

[0014]In the outside electroless plating method and plating device of a long pipe concerning this invention, the coat pipe which accommodated the long pipe in the inside concentrically is used as a plating tub, and the annular space between this coat pipe and long pipe serves as a plating room. And the outside surface of a long pipe is plated by supplying plating liquid to this annular plating room.

[0015]In any [of inner surface plating and outside plating] case, electroless plating liquid, It is a long pipe about the plating liquid made [feeds the plating interior of a room and] circulate in the one direction namely, sent from the plating liquid tank. (or coat pipe) It is preferred to circulate the plating interior of a room by feeding from one end to the plating interior of a room, and returning the plating liquid discharged from the other end to a tank. Thereby, many of gas, such as hydrogen generated at the time of plating, is discharged out of a pipe. When plating liquid flows through the inside of a long pipe, the temperature of the plating interior of a room is held uniformly, and the chemical reaction for a plating deposit occurs in a longitudinal direction uniformly in the plating interior of a room. Therefore, the plating coat of uniform thickness is formed covering an overall length, and thin plating in a center section which is seen by the electrolysis plating method is avoided.

[0016]It is avoided by making a hoop direction rotate a long pipe at the time of plating that the upper part is covered with the gas which remained in the pipe, and un-plating and a cellular crack occur locally. This rotation contributes also to the homogeneous improvement in plating.

[0017]By circulation feeding of the above plating liquid, and rotation of a long pipe, in spite of plating a long pipe with a horizontal position, There are few un-plating and cellular cracks, and they are thickness and a presentation. (when it is an alloy plating) A plating coat with good quality uniform about a hoop direction and the both directions of a longitudinal direction is formed in the inner surface or outside surface of a long pipe.

[0018]A plating room is used also for pretreatment in this invention.

Therefore, it is not necessary to install the processing tub for pretreatment independently.

In the case of resin pipes, such as an FRP tube with which degreasing and pickling consist of ABS, an epoxy resin, and glass fiber again, as plating pretreatment for nonelectrolytic plating, activation using a noble metal compound and a reducing agent is performed with metal tubes including a steel pipe. From the tank of the

treating solution for these pretreatments of each, a treating solution is supplied to the above-mentioned plating room one by one by the change of the valve provided in the pipe line, and it is each pretreatment. (degreasing, pickling, etc.) It carries out. Between each processing, it rinses by supplying water to the plating interior of a room from the pipe line, and liquid mixture is prevented. If required also at the time of plating pretreatment, it is also good to carry out circulation feeding of the treating solution like plating liquid at a plating room, or to make it stagnate. It is preferred to make a hoop direction rotate a long pipe like the time of plating.

[0019]Therefore, there should just be a size which can install a long pipe to be plated horizontally and can install the tank, and attachment piping and a support rolling mechanism of plating liquid and plating pretreatment liquid as a space, and it can carry out also at a narrow place. Since the plating room is narrow, there is also little amount of the expensive electroless plating liquid used, and it ends. Whole process of plating (example and degreasing -> rinsing -> pickling -> rinsing -> plating -> rinsing) Since it can carry out only by the change of the liquid type supplied to a plating room, without moving a long pipe to be plated, movement is suitable also for difficult Ryo Oshige's long pipe.

[0020]The construction material in particular of the long pipe in which nonelectrolytic plating is possible is not restricted by the method and device of this invention. It is applicable not only to various kinds of metal including a steel pipe, or the metal tube made from an alloy but resin pipes (a resin kind has an epoxy resin and preferred ABS plastics), such as an FRP tube. However, the kind of treating solution used for plating pretreatment may change according to the construction material of a long pipe. For example, in the case of a resin pipe, pretreatments are not degreasing and pickling. For example, induction-ized (SENSHITAIZESHON) processing by the solution containing a reducing agent (an example, Sn^{2+} ion) and activation by the solution containing precious-metals (example, Pd) ion are performed, and the core of the precious metals which have catalytic activity in the plating side of a resin pipe is formed beforehand.

[0021]There is no restriction also about a plating metal kind, and it can apply to the arbitrary metal or alloy platings in which nonelectrolytic plating is possible. As a plating kind, it is a nickel alloy, for example. (an example, nickel-B, nickel-P, etc.) Copper etc. are mentioned.

[0022]Although it is suitable for especially an inner surface and outside plating of the long metal tube with which plating by uprighting this invention exceeds 10 difficult m in length and weight 100 kg, there is no restriction in particular in the length and weight of a long pipe.

[0023]Hereafter, with reference to an accompanying drawing, the case where the plating method of this invention and a device are applied to a long metal tube is explained concretely. Drawing 1 shows the inner surface electroless plating equipment of this invention. The long pipe 10 to be plated is laid in the support rolling mechanism 20 by a horizontal position. The rolling mechanism 20 is provided with two or more rotary rollers 22 arranged in the tube axial direction of the long pipe 10, and, thereby, supports the long pipe 10 horizontally. the rotary roller 22 of each position -- the motor M of an attachment -- rotation of one way -- or a synchronous drive is carried out in right reverse both directions, and a hoop direction is made to rotate the long pipe 10

[0024]In the both ends of the long pipe 10, it is a closure lid of a screwed type. (flange) 40 is an annular seal ring (O ring). It is equipped via 42 and the building envelope A of a long pipe is sealed. In order to circulate treating solutions, such as plating liquid, toward the other end from one end of the building envelope A of a long pipe, the dipping hole 44 is formed in the closure lid 40.

[0025]It is hard to receive nonelectrolytic plating as construction material of the closure lid 40. (the surface is

inertness) The thing excellent in corrosion resistance is preferred. For example, although a synthetic resin, the stainless steel which is easy to form a passive state oxide film in the surface, or the metallic material which formed the oxide film in the surface by heat treatment can be used, especially a synthetic resin is preferred.

[0026]Each dipping hole 44 of the closure lid 40 of both sides is connected to the liquid supply mechanism 60 with a flexible hose. The liquid supply mechanism 60 can be provided with each tank of the degreasing liquid 62, the pickling solution 64, and the electroless plating liquid 66, and can feed independently degreasing liquid, a pickling solution, plating liquid, and wash water to the building envelope of the long pipe 10 by the change of the pump P, valve $V_1 - V_8$, respectively. The degreasing liquid 62 and electroless plating liquid are held at prescribed temperature by the steam heating device 68 formed in the tank.

[0027]In order to perform inner surface nonelectrolytic plating of this invention using the device shown in drawing 1, circulation feeding of the degreasing liquid 62 is first carried out to the other end in the one direction from one end in the building envelope A of the long pipe 10, and the inner surface of a long pipe is degreased. After degreasing is completed and degreasing liquid is thoroughly discharged from a long pipe, wash water is fed to the space A and the inside of a long pipe is washed. Subsequently, it rinses, after carrying out circulation feeding of the pickling solution 64 similarly and performing pickling of the inner surface of a long pipe. The motor of the support rolling mechanism 20 is operated during these the processings of each, and one-way rotation or right reverse both directions are made to repeat and rotate a long pipe. A dormant period is inserted between feeding of each liquid and wash water.

[0028]Then, rotating a long pipe by the support rolling mechanism 20, circulation feeding of the electroless plating liquid 66 is carried out in the one direction in the building envelope A of the long pipe 10, and the plating coat of predetermined thickness is formed in the inner surface of a long pipe. If it rinses by feeding wash water to the building envelope of the long pipe 10 after the end of plating, a series of plating will be completed. The operating program of the plating device at this time is shown in Table 1.

[0029]

[Table 1]

めっき操作の運転プログラム

| 工程 部位 | 脱 脂 | 休 止 | 水 洗 | 休 止 | 酸 洗 | 休 止 | 水 洗 | 休 止 | め っ き | 休 止 | 水 洗 | 休 止 | 終 了 |
|----------------|--------|--------|--------|--------|--------|--------|--------|--------|-------------|--------|--------|--------|--------|
| 圧送用 ポンプ | 開 | 閉 | 開 | 閉 | 開 | 閉 | 開 | 閉 | 開 | 閉 | 開 | 閉 | → |
| V ₁ | 開 | 閉 | | | | | | | | | | | → |
| V ₂ | 開 | | → | | 開 | 閉 | | | | | | | → |
| V ₃ | 閉 | | | | | | → | | 開 | 閉 | | | → |
| V ₄ | 開 | → | 閉 | | | | | | | | | | → |
| V ₅ | 閉 | | → | | 開 | → | 閉 | | | | | | → |
| V ₆ | 閉 | | | | | | → | | 開 | | | | → |
| V ₇ | 閉 | → | 開 | 閉 | | → | 開 | 閉 | | → | 開 | 閉 | → |
| V ₈ | 閉 | → | 開 | → | 閉 | → | 開 | → | 閉 | → | 開 | → | 閉 |

[0030]The part drawing of the outside electroless plating equipment of this invention is shown in drawing 2. That this outside plating device differs from the inner surface plating device shown in drawing 1 is the point of

having inserted the long pipe 10 in the inside of the coat pipe 70, and having laid the outside coat pipe 70 at a level with the support rolling mechanism 20. In order to plate the outside surface of the long pipe 10 covering an overall length, it is preferred to lengthen the coat pipe 70 a little from a long pipe.

[0031]The long pipe 10 inserted in the inside of the coat pipe 70 is concentrically supported by a horizontal position with the coat pipe 70 with the closure lid 40 of a screwed type with which the both ends of the coat pipe 70 were equipped. The annular seal ring 42 is made to intervene between the end faces of the closure lid 40, the coat pipe 70, and the long pipe 10, and the annular space B formed between the coat pipe 70 and the long pipe 10 is sealed. The closure lid 40 equips this annular space B with the dipping hole 44 for circulating a treating solution. The construction material of the closure lid 40 and the coat pipe 70 may be the same as that of what was explained about the closure lid of drawing 1.

[0032]Outside nonelectrolytic plating of this invention using the device shown in drawing 2 is intrinsically carried out like the above-mentioned inner surface nonelectrolytic plating. That is, except for the point rotated together with the long pipe 10 which fed each treating solution not to the building envelope of the long pipe 10 but to the annular space B between the long pipe 10 and the coat pipe 70, and accommodated the coat pipe 70 in the inside concentrically, operation is the same. This becomes possible to carry out difficult outside nonelectrolytic plating of a long pipe easily conventionally at a narrow place.

[0033]Also in which nonelectrolytic plating of the above-mentioned inner surface and an outside surface, unplating by generating gas, generating of a cellular crack, and uneven plating of a hoop direction are prevented by rotation of the 1 direction circulation feeding of plating liquid and a long pipe. The automatic control of the change of a liquid type or the rotatably operating of the long pipe 10 can be carried out by an external program controller. When a twist of a hose does not take place by use of a rotary joint etc., a hand of cut can be rotated in the one direction instead of right reverse both directions.

[0034]The pumping speed of plating liquid has the desirable above 0.1 v/m (V is the capacity of the plating room A or B, i.e., space). If this pumping speed is small, sufficient gas discharge effect is not acquired and the temperature of a long pipe may be unable to be held. Since the increase of the load of a pump and a large-sized pump are needed when pumping speed becomes excessive, less than 3V is usually enough. As for the revolving speed of a long pipe, 1 rpm or more is desirable. Since rotation will become unstable if revolving speed is too high, 5 rpm or less is [below 10 rpm] usually enough.

[0035]

[Example]

(Example 1) Electroless nickel plating was performed to the inner surface of the long steel pipe by the following condition using the inner surface plating device concerning this invention shown in drawing 1.

Rotation of the steel pipe under pretreatment and plating was carried out to connection of the hose to a dipping hole in the one direction using the rotary joint.

[0036]A steel-pipe size for plating: Outer diameter 168 mm, inside diameter 152 mm, nature:polyvinyl-chloride-resin degreasing condition degreasing liquid:of length 12.0m (capacity of building envelope = 218 L)

construction material:carbon steel closure cover material3% alt.silic acid soda water solution condition:

Temperature of 60-70 **, pickling condition pickling solution during time 5 minutes: -- 10% chloride (for

ordinary temperature and 2 minutes) plating condition plating liquid: -- commercial electroless nickel plating

liquid (the product made from the Kamimura industry.) NIMUDEN super temperature: 90 **2 ** time: . 30-

minute pumping speed each treating solution: A part for 50 L/ (.) 0.23v [/] minute plating liquid: A part for 400

L/ (a part for 1.83v/) Water washing : A part for 80 L/ (a part for 0.37v/) Steel-pipe revolving speed: 2 rpm of nickel plating layers were formed in the overall length of the inner surface of 12.0 m in length (1 direction rotation) a long steel pipe. The thickness of the plating layer was uniform in the longitudinal direction and the hoop direction, and all were 18×0.5 μm in the perimeter of tube ends and a center section. When plating appearance was inspected with the naked eye, neither un-plating nor a cellular crack was accepted.

[0037](Example 2) Nonelectrolytic plating copper plating was given to the outside surface of the long steel pipe by the following condition using the outside plating device concerning this invention shown in drawing 2.

Rotation of the steel pipe under pretreatment and plating and a coat pipe was carried out to connection of the hose to a dipping hole in the one direction using the rotary joint.

[0038]A steel-pipe size for plating: Outer diameter 168 mm, inside diameter 152 mm, length 4.0 m construction material:carbon steel coat pipe size:outer diameter 267 mm, the same plating condition plating liquid:marketing radio solution copper plating solution (the product made from the Kamimura industry.) as the construction material:example 1 of a 240-mm and inside diameter 4.01-m construction material [in length]:polyvinyl-chloride-resin (capacity of annular space between steel pipes = 92 L) closure lid, and the same degreasing / pickling condition:example 1 Sour Kapp ELC-SR temperature: 55×1.5 . ** time: 25-minute pumping speed each treating solution: 30. L / part (a part for 0.32v/) plating liquid: A part for 200 L/ (a part for 2.18v/) Water washing: A part for 80 L/ (a part for 0.87v/) A steel pipe / coat-pipe revolving speed: The copper plating layer was formed in the overall length of the outside surface of the long steel pipe of the same ***** 4.0 m as Example 1. The thickness of the plating layer was uniform in the longitudinal direction and the hoop direction, and all were 1×0.2 μm in the perimeter of tube ends and a center section. When plating appearance was inspected with the naked eye, neither un-plating nor a cellular crack was accepted.

[0039](Comparative example 1) Nonelectrolytic plating nickel plating was performed to the inner surface of 12.0 m in length a long steel pipe like Example 1 except having suspended rotation of the long steel pipe under pretreatment and plating. As a result, although plating thickness was almost uniform covering the overall length of 12.0 m in length a steel pipe, the linear unplated part occurred in the ceiling part of the steel pipe.

[0040](Comparative example 2) Nickel plating was performed to the inner surface of the long steel pipe by the electrolysis plating method using the same device as drawing 1. However, in order to perform energization required for electrolysis plating, in the device of drawing 1, long tubular electrodes thinner than a long pipe were concentrically inserted in the inside of the long steel pipe 10, and the annular space between a steel pipe and an inner pipe-like electrode was used for it as a plating room. It set like the degreasing process and the plater, and energization was performed from the external power so that internal tubular electrodes might turn into the anode and a long steel pipe might serve as the negative pole. The conditions of each processing are shown below.

[0041]A steel pipe size for plating : Outer diameter 168 mm, inside diameter 152 mm, and length 7.5 m construction material:carbon steel inner pipe-like electrode size:outer diameter 70 mm, The same degreasing condition degreasing liquid:3% alt.silic acid soda water solution condition as the construction material:example 1 of an inside diameter 46 mm and length 8.0 m construction material:SUS 304 stainless-steel (capacity of steel pipe and inter-electrode annular space = 107 L) closure lid : The temperature of 60-70 **, current density 4 A/dm^2 , Time 2 minute pickling condition pickling solution: 10% chloride (for ordinary temperature and 1 minute) Plating condition plating liquid: Watts bath (pH 3.5)

nickel sulfate 250 g/l nickel chloride . 70 g/l boric acid 40 g/l temperature: . 40-50 ** current density: -- 5 A/dm^2

time (part for 0.75v/) steel pipe revolving speed: -- 4 rpm (during plating and degreasing) : 25-minute pumping speed each treating solution: A part for 50 L/ (a part for 0.47v/) plating liquid: -- a part for 107 L/ (a part for 1.0 V/) Water washing: A part for 80 L/ The nickel plating layer was formed in the overall length of the inner surface of the long steel pipe of right reverse repetition rotation length 7.5 m. However, the thickness of a plating layer is a maximum of 26 micrometers. (tube ends) A minimum of 18 micrometers (center section) It is and the range of fluctuation of the longitudinal direction amounted to 8 micrometers. The range of fluctuation of the plating thickness of this longitudinal direction decreased to 2 micrometers, when the length of the long steel pipe became short with 3.5 m. Therefore, if the length of a long steel pipe becomes long with 12.0 m like Example 1, the range of fluctuation of the longitudinal direction of plating thickness will become still more nearly remarkably large rather than 8 micrometers. On the other hand, in the nonelectrolytic plating method of Example 1, the range of fluctuation of the longitudinal direction of the plating thickness in a long steel pipe 12.0 m in length was very small compared with 1 micrometer and the electrolysis plating method, and ended.

[0042] Since the long steel pipe was rotated during plating, the range of fluctuation of the plating thickness of a hoop direction was as small as $18 \times 0.5 \text{ } \mu\text{m}$ in $26 \times 0.6 \text{ } \mu\text{m}$ and the center section in tube ends.

[0043]

[Effect of the Invention] The following point can be mentioned as an effect of this invention.

** Both inner surface plating of a long pipe and outside plating can be carried out.

** Even when plating a long pipe which exceeds 10 m by feeding and circulating plating liquid, there is little change of the plating thickness of the longitudinal direction of a pipe remarkably. In an electrolytic decomposition process, even if it feeds plating liquid, thin plating of a center section is unavoidable. Plating thickness becomes uniform by rotating a long pipe during plating even in the hoop direction of a long pipe. Therefore, the plating coat in which the both directions of a longitudinal direction and a hoop direction had uniform thickness is formed.

[0044]** As a result of discharge out of air bubbles' or the pipe of gas being promoted by feeding of plating liquid, and rotation of a long pipe and the local stagnation being prevented, few plating coats of un-plating or a cellular crack are formed.

[0045]** It can carry out almost automatically by operating the valve in which from plating pretreatment to nonelectrolytic plating was formed by an external pump and each tank in the state where it has arranged horizontally, without moving a heavy long pipe.

[0046]** Inside of a long pipe to be plated (in the case of inner surface plating) Or annular space between the coat pipe and long pipe which accommodated the long pipe (in the case of outside plating) Since it uses as a plating room, The capacity of a plating room is comparatively small, and there is little amount of each treating solution used containing expensive electroless plating liquid, and it ends, and the discharge's of the polluted wash water decreases.

** Since the same processing unit as plating performs degreasing and pickling, it can carry out in a comparatively narrow space.

[Translation done.]

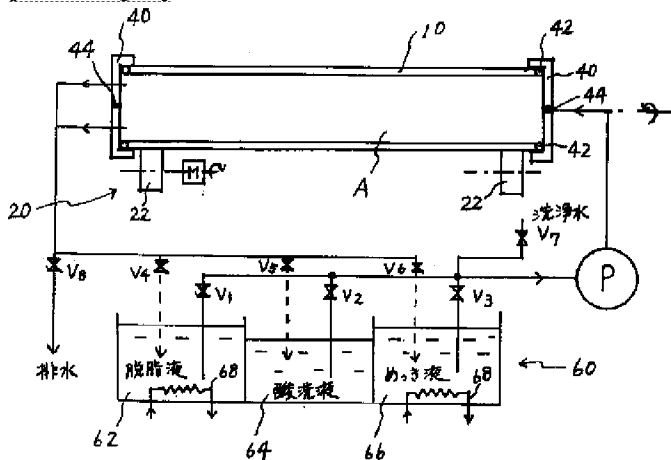
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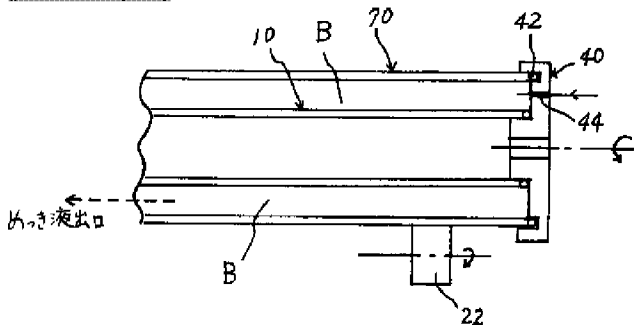
- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.**** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]



[Drawing 2]



[Translation done.]